

# RESERVE COPY PATENT SPECIFICATION

417,648



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## COMPLETE SPECIFICATION.

### Improvements in Means for Controlling Driving Gear of Automobiles.

We, BENDIX AVIATION CORPORATION, incorporated under the laws of the State of Delaware, United States of America, of 105, West Adams Street, Chicago, Illinois, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to control mechanism for the transmission system between the engine and the road wheels of an automobile.

The invention is concerned with the control of a transmission system which includes both a main change speed transmission, such as a transmission providing forward and reverse speeds, and an auxiliary change speed transmission, such as one providing an upper and lower variant upon each of the possible ratios of the main transmission.

According to this invention the control mechanism for an automobile comprises a fluid-actuated main-gear-shifting motor and a fluid-actuated auxiliary-gear-shifting motor which are simultaneously energised upon operation of a common control.

According to a further feature of the invention, the control mechanism for an automobile, wherein a main transmission gear having forward and reverse speeds is combined with a two-speed auxiliary transmission gear, is characterised in that the two motors, one controlling each transmission change gears, have a common control.

The invention will be described with reference to the accompanying drawings, showing a convenient embodiment of the invention; wherein:

Fig. 1 is a diagrammatic assembly view, mostly in plan but partly in vertical section through the floorboard and the instrument board to show some of the controls, of an automobile chassis embodying our invention;

Fig. 2 is a horizontal section through the transmission-differential unit shown in plan in Fig. 1;

Fig. 3 is a horizontal section through the high-second gearshift vacuum unit,

this unit being shown in plan in Fig. 1 and being located just above the lower right-hand portion of Fig. 2;

Fig. 4 is a horizontal section, corresponding to the upper left-hand portion of Fig. 2, of a modified form of power unit for the low-reverse gear-shift.

Fig. 5 is a vertical section on a larger scale than the corresponding part of Fig. 1; through part of the floorboard and through the control for the high-second gearshift;

Fig. 6 is a section through a modified form of gearshift power unit;

Fig. 7 is a diagram showing the control of a power unit such as the one shown in Fig. 6.

The automobile chassis selected for illustration includes an internal combustion engine 20, having the usual intake manifold 22 and carburettor 24, with the passage from the carburettor to the manifold controlled by the usual throttle valve having an operating arm 26. The throttle arm 26 is connected, by means such as a lengthwise movable rod 28, with an accelerator pedal or the like 30, and is ordinarily also independently operable through a second lost-motion connection 32, for example by the usual hand throttle lever on the steering column. The accelerator pedal 30 or its equivalent is pivotally mounted on the floorboard 34, for manipulation by the toe of the driver's right foot. The rod 28 has a lost-motion connection with the throttle arm 26, so that it may have a short additional motion (for manipulating the clutch-control valve described below) after the throttle is closed.

The engine is arranged to drive the vehicle by driving road wheels 36 through axle shafts 38.

The present invention has mainly to do with the power-transmitting mechanism through which the engine 20 drives the axle shafts 38 or their equivalents, and to a system of simplified controls therefor.

Immediately behind the engine fly-wheel and its housing 40 is arranged a clutch of any desired character, in a clutch housing 42, through which clutch the engine drives a propeller shaft 44.

The clutch is operated, against the resistance of the usual clutch springs (not shown), by a power device 52. The arrangement is the well-known one such that the clutch is automatically disengaged whenever the accelerator pedal is released, and is re-engaged upon depressing the accelerator pedal, the speed of re-engagement being controlled according to the engine speed.

Provision may be made for the clutch to be actuated directly by the driver if for any reason the power clutch operator fails to work.

The propeller shaft 44 drives the rear axle shafts 38 through a unit, preferably supported on the chassis frame and shown in top plan in Fig. 1 and in horizontal section in Fig. 2, and which in the particular embodiment shown in these figures includes the following principal parts: (1) a low - speed - direct - drive - reverse change-speed gearing with a vacuum power operator, (2) a high-second-gear-shift independent of (1) and also provided with a vacuum power operator, (3) a differential or its equivalent, being shown as one form of what is usually called a "locking differential", (4) a free wheel drive to each shaft 38, (5) a lockout, preferably power-operated, for the free wheel drives, and (6) a pair of hydraulic or other brakes acting on the wheels 36 through the axle shafts 38.

The above parts are all carried by, and are mostly housed within, a housing or gear-box 84 formed in suitable sections bolted together.

The propeller shaft 44 (which may if desired have universal joints 86 at its forward and rear ends) drives a short shaft 88 (Fig. 2) journaled in a bearing 90 carried by the gearbox 84, and formed at its rear end (inside the gearbox) as a small pinion meshing with and driving a large gear 92 forming part of a three-gear cluster rotatably mounted on a fixed countershaft 94. The gear cluster also includes a medium sized gear 96 and a small gear 98, the last-named gear meshing with a reverse idler gear 100 (carried by a removable cap above or below the plane of Figure 2, and therefore indicated in dotted lines).

Piloted in the rear end of shaft 88, in the roller bearing 102, is the forward end of a driven shaft 104 splined or keyed at its rear end to an aligned pinion shaft 106 journaled in bearings 108 and 110 carried by the gear-box 84. Splined on the driven shaft 104 is a movable driven gear 112 slidable by a suitable shifter fork 114 from the neutral position shown in Figure 2, rearwardly to mesh with gear 96 or reverse gear 100, or forwardly to

bring clutch portions on its forward face into interengagement with corresponding clutch portions on the rear face of the pinion and shaft 88 to give direct drive (this last being the normal position of gear 112).

The shifter fork 114 or its equivalent is carried by means such as a lengthwise-slidable shifter rod 116 having a series of notches interlocking with a spring-pressed ball 118 to give the following positions, in order from the lower (rear) end of the rod: (1) direct drive, (2) neutral, (3) low gear (in mesh with gear 96), (4) neutral, and (5) reverse (in mesh with gear 100).

The shifter rod 116 is shown rigidly secured, by a crossbar or the like 120, to a piston rod 122 carried by a double-acting piston 124 in a power cylinder 126 mounted on the gear-box 84. The piston rod 122 is hollow, and contains a slide valve 128 controlling a passage 130 opening through the piston 124 into the space below (behind) the piston, and a passage 132 opening above (ahead of) the piston.

The upper end of the hollow piston rod communicates with the atmosphere through openings in a plug 134 threaded into the end of the piston rod, and the lower end of the hollow piston rod communicates with the atmosphere through a passage 136 which opens outside the power cylinder in all positions of the piston. A flexible vacuum connection 138 opens inside the hollow piston rod through a passage 138' opening through an internal collar 140 substantially midway of the piston rod and which passage is controlled by the slide valve 128.

The valve 128 is of the follow-up type, and includes three disconnected parts, viz.: upper and lower valve slides each having an annular external groove and passages therefrom leading out through the end of the slide away from the collar 140, and a central operating button with rounded ends fitting into seats in the adjacent faces of the valve slides, and which is of a size to pass easily through the collar 140, and which is carried by and secured to the end of a relatively stiff Bowden wire 142 passing through the plug 134.

In the operation of the power device just described, the valve 128 can be pre-set for any gear position desired, before suction is applied through conduit 138. If the wire 142 and button on its end are pushed downwardly (i.e. rearwardly), the lower slide valve will be pushed down to a corresponding position. This connects the vacuum conduit 138 through passage 130 with the space below (behind) the piston 124, leaving the space above (in front of) the piston connected to the atmo-

sphere. Or if the wire is pulled upwardly (forwardly) instead, the upper valve slide is pulled in a corresponding direction, connecting the vacuum conduit 138 through passage 132 with the space above (in front of) the piston 124, leaving the space below (behind) the piston connected to the atmosphere.

When now the vacuum is applied through conduit 138, the piston 124 follows the valve until the latter regains the position of parts shown in Figure 2, thereby shifting the gears to the position for which the valve 128 was pre-set.

The Bowden wire 142 is shown passing through a Bowden conduit 144, and as being connected at its forward end to a pre-selector handle 150. The handle 150 is formed with a pointer passing over a scale indicating the different gear positions.

A valve 141 is also connected to Bowden wire 142 through the medium of a transfer lever 143 and operates to admit atmosphere to the cylinder 298 through the rearward portion of conduit 306 when the selector handle 150 is moved into reverse position thus providing positive drive in reverse speed.

The conduit 138, as shown in Fig. 1, is connected to the clutch control vacuum conduit 76, so that the selected shift of the gears is made by releasing the accelerator pedal, which at the same time throws out the clutch. The gearshift and the clutch control are therefore interlocked, and it is impossible to shift the gears accidentally when the clutch is engaged.

In the arrangement of Figs. 6 and 7, an arrangement is shown for operating the gearshift directly from the handle 150, i.e. without preselection, should the power fail.

In this arrangement the handle 150 is connected through a linkage 166 with the front portion 168 of a two-part piston rod. Portion 168 telescopes into an outer portion 170 to which the crossbar 120 and therefore the shifter rod 116 are connected.

A vacuum connection 172, corresponding to connection 138, and connected, either to conduit 76 if an interlock with the clutch control is desired, or directly to the manifold 22 if no interlock is desired, is secured to piston rod portion 168 in communication with a vacuum passage 174 opening outwardly through a collar 176 near the lower (rear) end of the piston rod.

An air passage 178 runs from a groove 180 in the piston rod and opens through its lower (rear) end. Air passages 182 are provided between the telescoping piston

rod sections 168 and 170, for example by making the latter a loose fit about the former, and an opening 184 provides communication between these air passages and groove 180.

The outer piston rod section 170 is secured at its lower (rear) end to a valve chamber 186 carrying a double-acting power piston 188 corresponding to piston 124. The valve chamber is formed with four conical seats for valves 190, 192, 194, 196 sleeved on the inner piston rod section 168, with a valve spring 198 compressed between valves 190 and 192, and a valve spring 200 compressed between valves 194 and 196. The collar 176 is arranged between the valves 192 and 194, and has a short lost motion before engaging either of them. The valve chamber is formed with ports 202 from the space between valves 190 and 192 to the space below (behind) the piston, and with ports 204 from the space between valves 194 and 196 to the space above (in front of) the piston. A cup-shaped cap 206 forms a chamber over the lower end of the valve chamber 186.

In operation, with the parts as shown the vacuum connection is sealed off by the valves 192 and 194, which are held against their seats by springs 198 and 200. The space above (in front of) the piston communicates with the atmosphere through ports 204, past the open valve 196, and through passages 182. The space below (behind) the piston communicates with the atmosphere through ports 202, past the open valve 190, through passage 178, groove 180, port 184, and passages 182.

If now tension is applied to connections 166, part 168 shifts upward (forward), first closing valve 196 and then (by contact with collar 176) opening valve 194, thereby opening communication between the vacuum passage 174 and the space above (ahead of) the piston. The piston then follows up until the positions shown in Figure 7 are regained. The reverse action takes place if connections 166 are manipulated to push piston rod 168 downward (rearward). In case of failure of the power, after a short lost motion the above-described connections shift the gears manually.

In Figure 4 is shown a modification of the power operator of Figures 1 and 2. The principal difference is that the connections are all made at the end of the piston rod, instead of about the center of it, thus necessitating lengthening some of the passages but shortening the assembly somewhat.

Returning now to Figure 2, the pinion shaft 106 has rotatably sleeved thereon a

pair of bevel pinions 210 and 212, of different sizes, meshing respectively with a pair of different-sized bevel ring gears 214 and 216. Splined on the pinion shaft 106 are a pair of dog clutches 218 and 220, rigidly connected to be moved in unison by shifter forks 222 and 224 which are rigidly connected for operation by the same vertical lever 226. Shifting this assembly downwardly (rearwardly) interlocks clutch 220 with pinion 212 and gives one speed; shifting it upwardly (forwardly) interlocks clutch 218 with pinion 210 and gives a different speed.

The piston 230 which operates the above described gearshifting means has its upper end connected to a piston rod 228 (Figure 3) operated by a double-acting piston 230 in a cylinder 232 mounted on the top of the gear-box 84. The piston rod 228 is formed with a vacuum passage 234 communicating with a flexible vacuum conduit 236, and with an air passage 238 having an air intake 240 to which a suitable extension, conduit, or air filter, may be secured if desired.

The piston 230 is mounted on a slide valve member 242 sleeved on the piston rod 228 between two abutments shown as provided by snap rings 244 and 246 seated in grooves in the piston rod. The slide valve 242 is formed with ports registrable with openings through the sides of piston rod 228. The ends of the passages 234 and 238 are closed by plugs 248. Springs 250 and 252 clipped to the opposite ends of the cylinder 232, engage the piston 230 and slide valve 242 near the opposite ends of its stroke.

The vacuum line 236 is connected to a "T"-fitting 254 in the clutch control line 76 (to interlock this gear-shift also with the clutch control) through a valve 256 shown in detail in Figure 5. This valve includes a valve cylinder 258 bolted to the lower face of the floorboard 34 over an opening therein, and containing a valve piston 260 urged upward by a fairly stiff spring 262, and having a guide plunger 264 extending through the floorboard and engaged by a heel rest or pedal 266 pivotally mounted on the floorboard just below the accelerator pedal 30, in such a position that when the toe of the driver's right foot is on the accelerator pedal his heel is on the rest 266.

It will be seen that when the driver lifts the toe of his right foot, thereby throwing out the clutch, he may go on and depress his heel, thereby admitting vacuum to the power device of Figure 3 and shifting from whichever pinion-and-bevel-gear he has been using to the other

one and thereby in effect changing gears,—or, more accurately, changing speeds, since there is direct drive in both of these speeds.

The above-described power unit piston rod is shown in Figure 3 at the upper and foremost end of its stroke, with pinion 212 driving ring-gear 216. If the valve 256 is manipulated as described above (and with the clutch control valve 78 also opened if the devices are interlocked with each other as shown in Figure 1), vacuum enters through conduit 236, passage 234, and the registering ports in the piston rod and the slide valve 242, behind the piston, while the atmosphere communicates with the space ahead of the piston through passage 238 and the registering ports in the piston rod and slide valve ahead of the piston. The piston thereupon moves toward the other extreme of its movement, engaging near the end of its stroke the spring 250, and shifting the clutch 220 out of engagement with pinion 212 and the clutch 218 into engagement with pinion 210, thereby changing speeds.

Now when the heel is raised and the suction is cut off from conduit 236, air enters through a port 268 (Fig. 5) into the space behind piston 230. With the air pressures now balanced on opposite sides of piston 230, spring 250 shifts the slide valve 242 against the abutment 244, ready for the next cycle of operations.

The two ring gears 214 and 216 are bolted or otherwise secured together, and are shown by way of illustration as driving the axle shafts 38 through what is known as a "locking differential" and "free-wheel" devices, the arrangement being such that the free wheel may be locked out if desired. The locking is effected automatically by the power cylinder 298 when reverse gear is put into operation as previously described.

In our co-pending application No. 20,601/33, bearing the same date as the present application, an invention is disclosed and claimed consisting of a control mechanism for a power actuated variable speed gearing between an engine and its load, wherein the servo-motor actuating the gearing, first set to determine the gear change, is energised to effect the gear change in consequence of closure of the engine throttle and simultaneously with disengagement of the engine from its gearing. What is claimed in that application forms no part of the present invention, and to it we here make no claim.

Also, in our prior patent application No. 35,068/32, Serial No. 416,407, is claimed a clutch control mechanism for a change-speed gearing in a motor vehicle

in which a fluid operated motor for operating a clutch and a fluid operated motor for operating an auxiliary two-speed transmission combined with a main transmission are controlled by a common valve operated from the accelerator pedal and interposed between the motors and a source of energy. To what is claimed in that application no claim is here made.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is, excluding the matter specifically disclaimed above:—

1. A control mechanism for an automobile, wherein a fluid-actuated main-gear-shifting motor and a fluid-actuated auxiliary-gear-shifting motor are simultaneously energised upon operation of a common control.

2. A control mechanism for an automobile, wherein a main transmission gear having forward and reverse speeds is combined with a two-speed auxiliary transmission gear, characterised in that two motors, one controlling each transmission change gear, have a common control.

3. A control mechanism for an automobile according to claim 1 or 2, wherein the motors may be energised only when the clutch is disengaged.

4. A control mechanism for an automobile according to claim 3, wherein the motors are controlled by the control of a clutch-operating motor.

5. A control mechanism for an automobile according to any of the preceding claims, wherein the motors are energised by the engine vacuum.

6. A control mechanism for an automobile according to any of the preceding claims, wherein the motors are controlled by the accelerator pedal of the automobile.

7. A control mechanism for an automobile according to claim 5 or 6, wherein the clutch motor is energised to disengage the clutch when the accelerator pedal is released.

8. A control mechanism for an automobile according to any of the preceding claims, wherein an auxiliary control is provided between the common control and the auxiliary transmission motor.

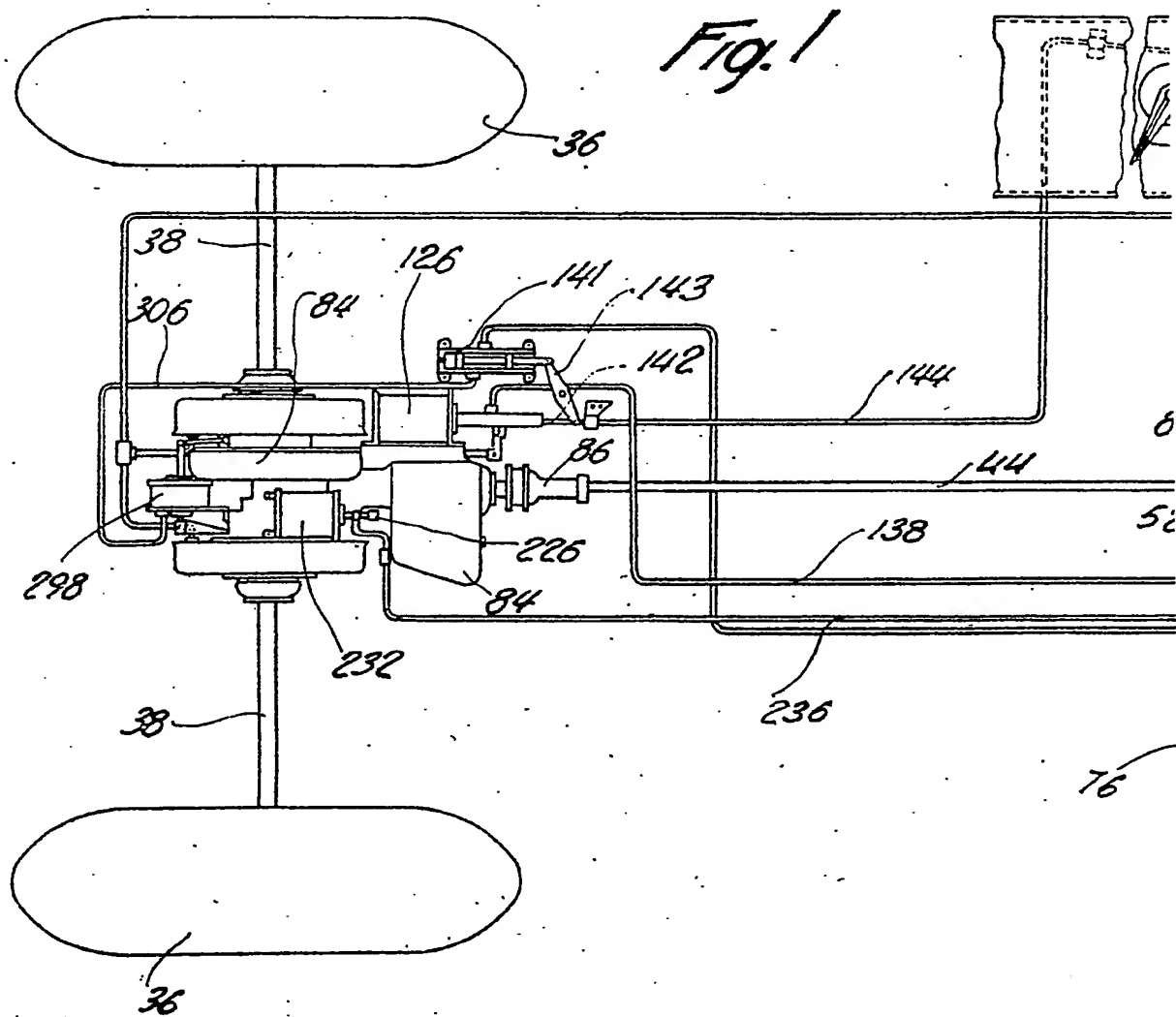
9. A control mechanism for an automobile according to claim 8, wherein the auxiliary control is disposed adjacent the accelerator pedal so as to permit actuation thereof by the same foot which actuates that pedal.

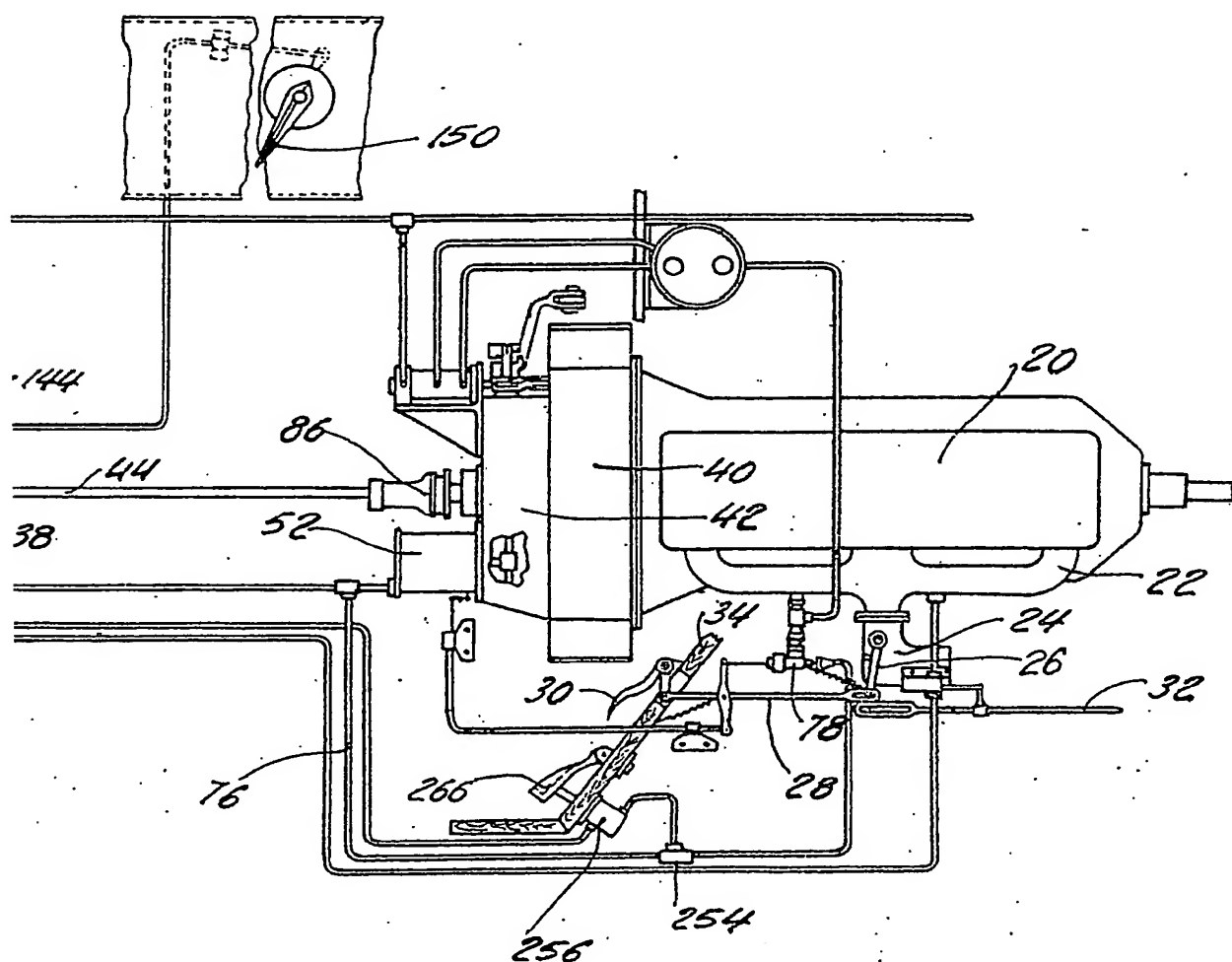
10. A control mechanism for the main and auxiliary change-speed-transmissions of an automobile substantially as described with reference to the accompanying drawings.

Dated this 4th day of February, 1933.

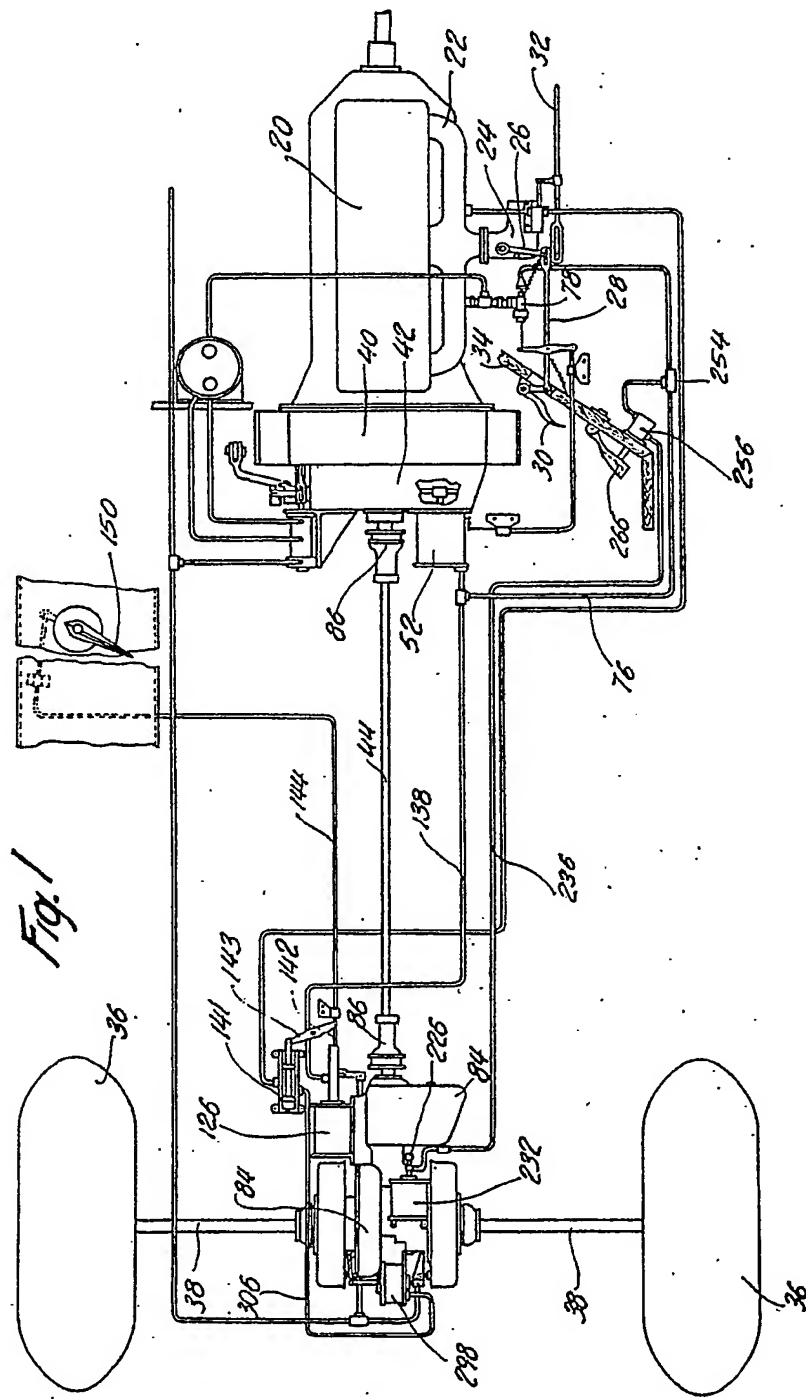
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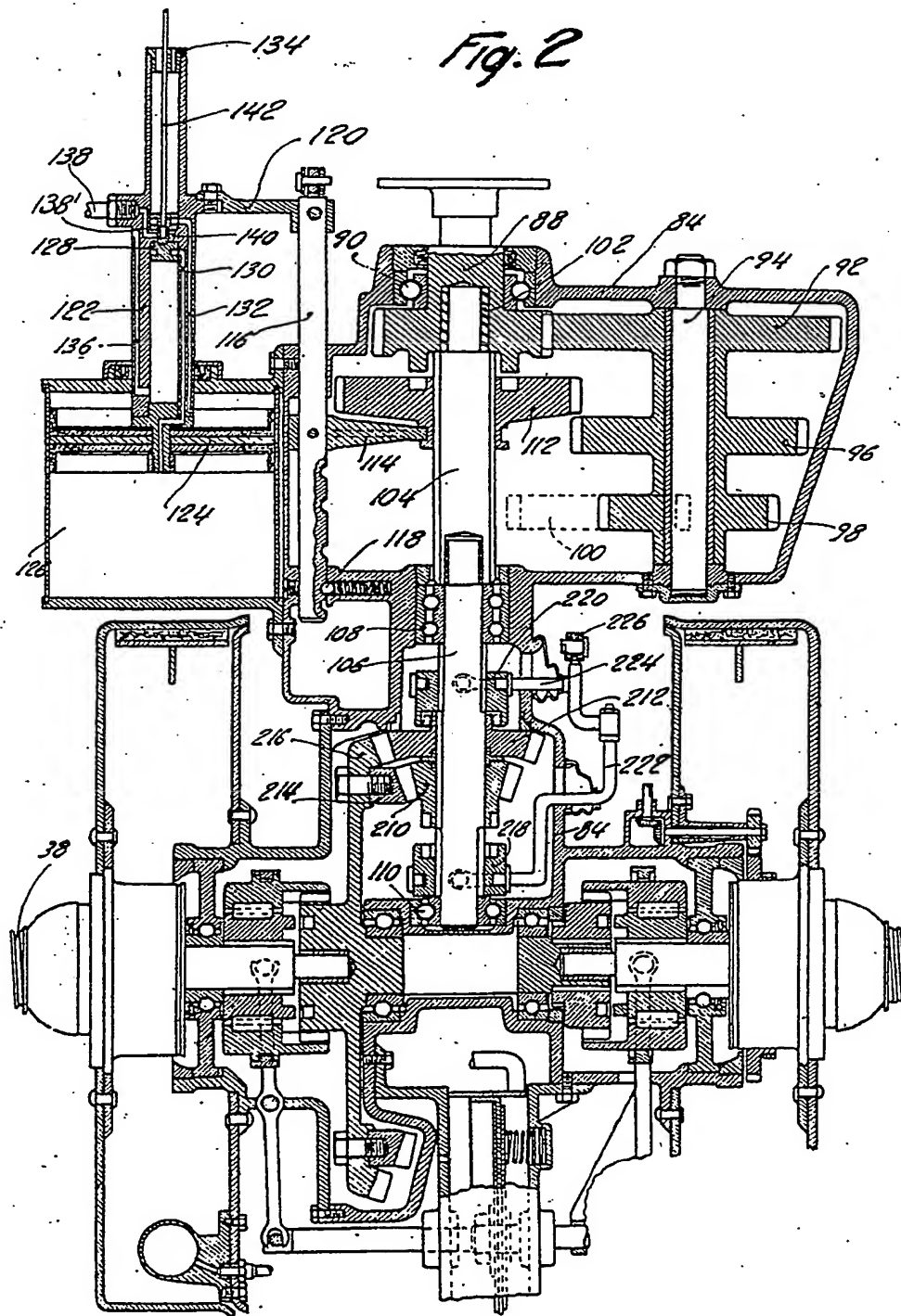
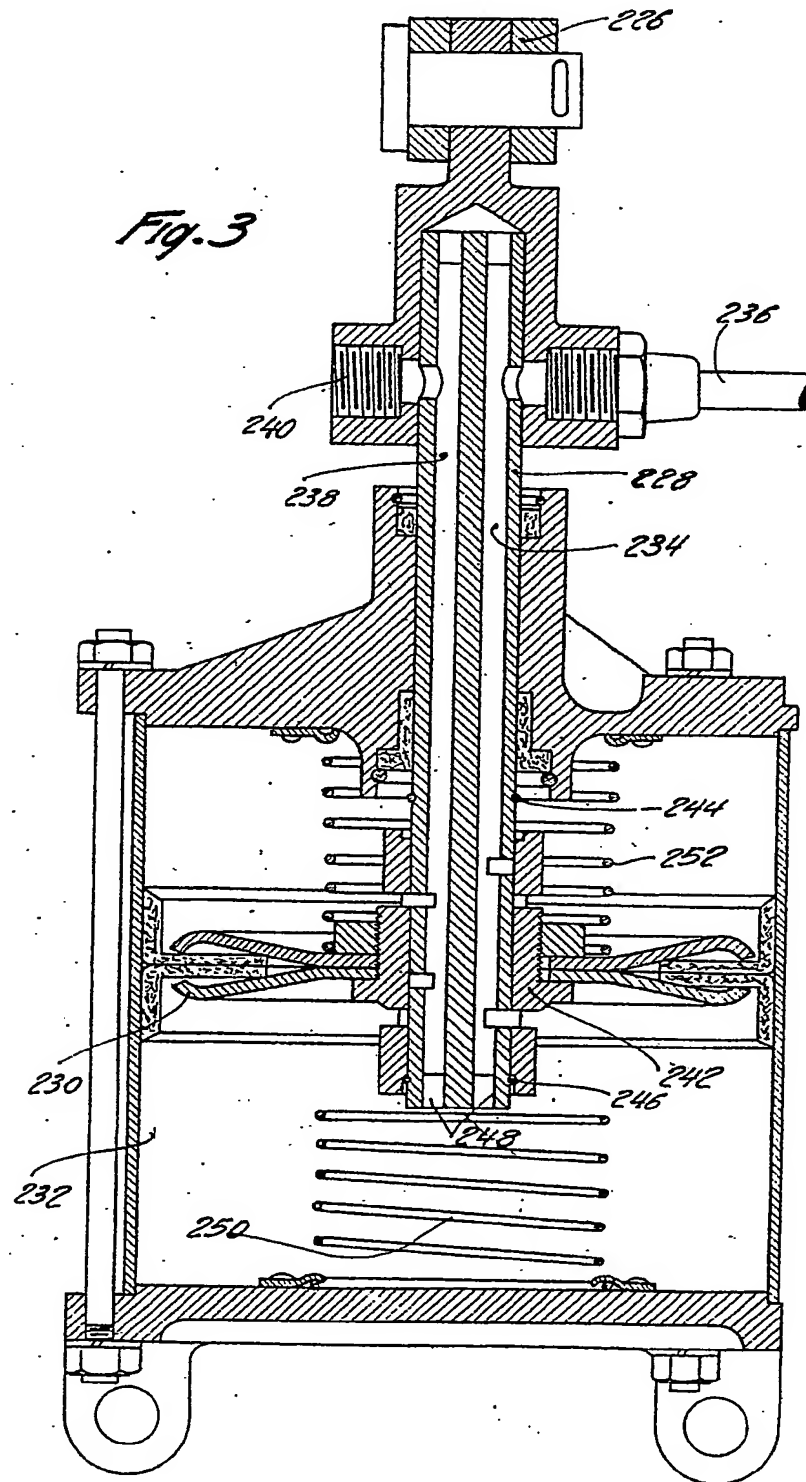


Fig. 3



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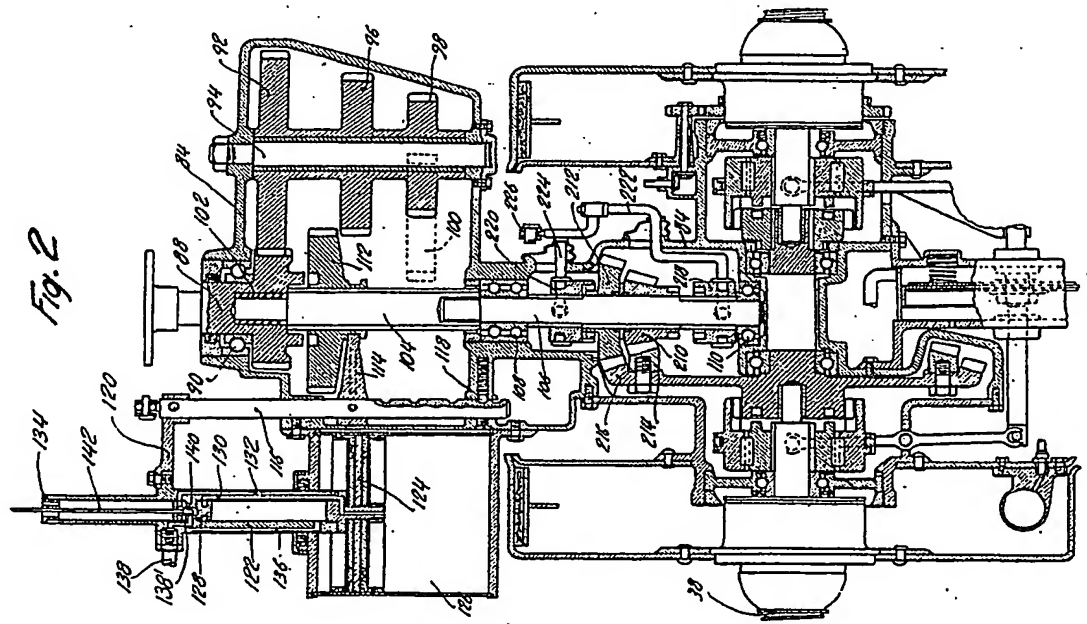


Fig. 2

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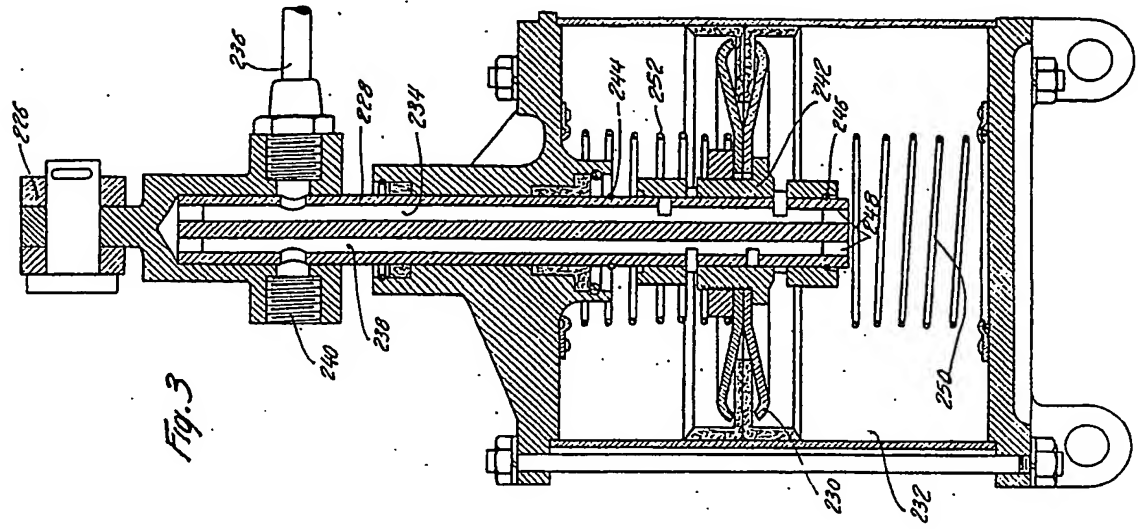
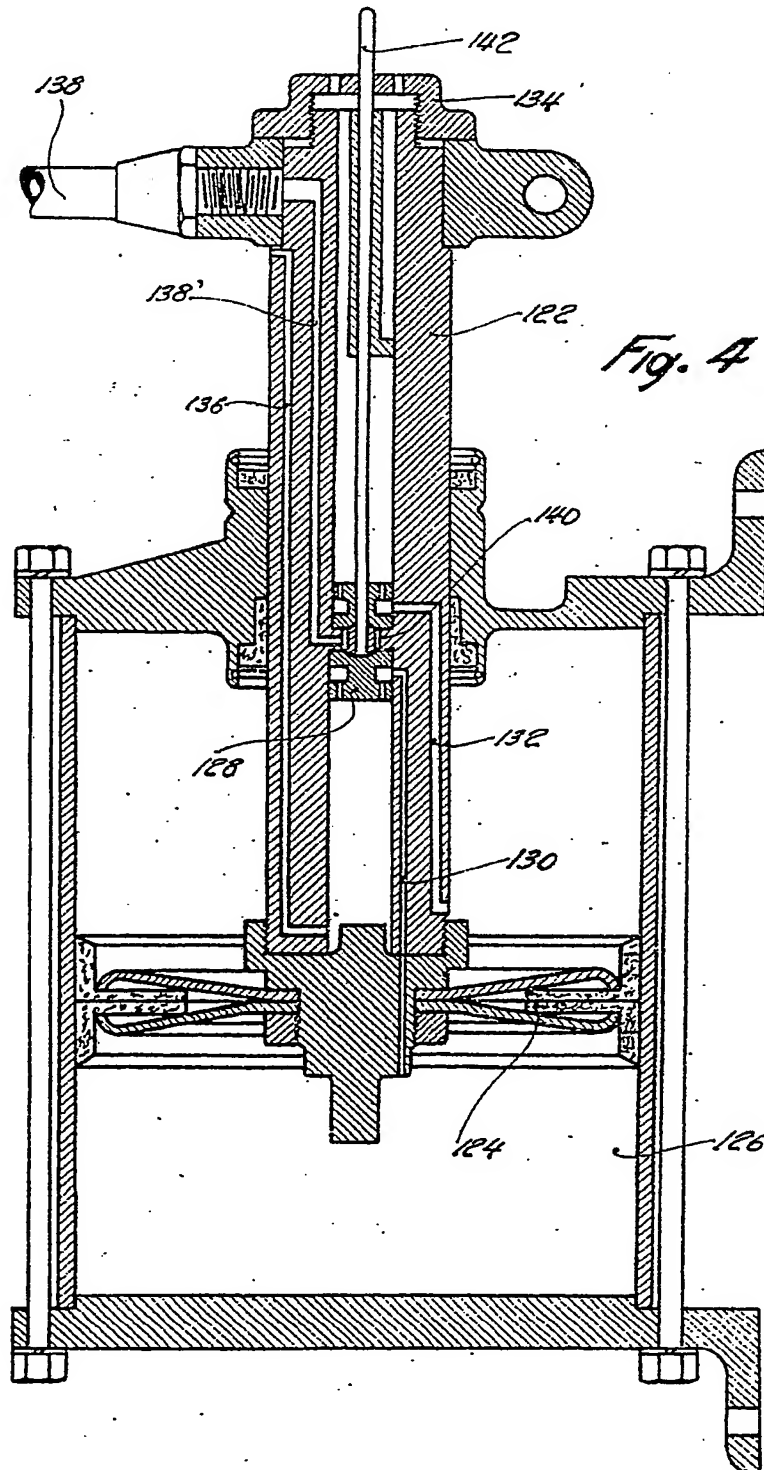
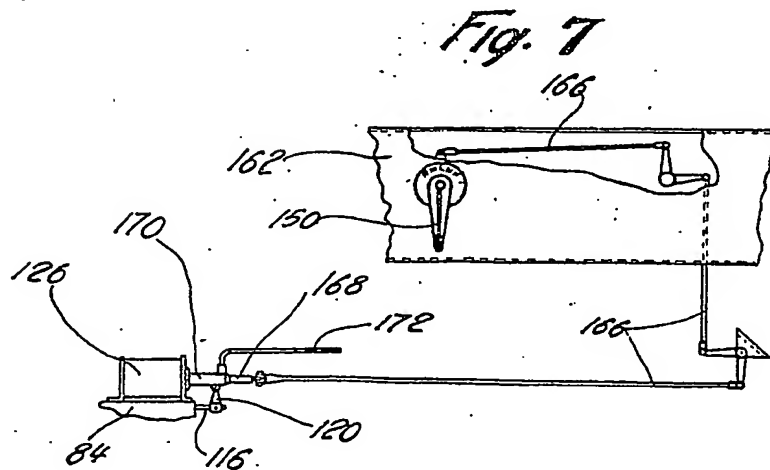
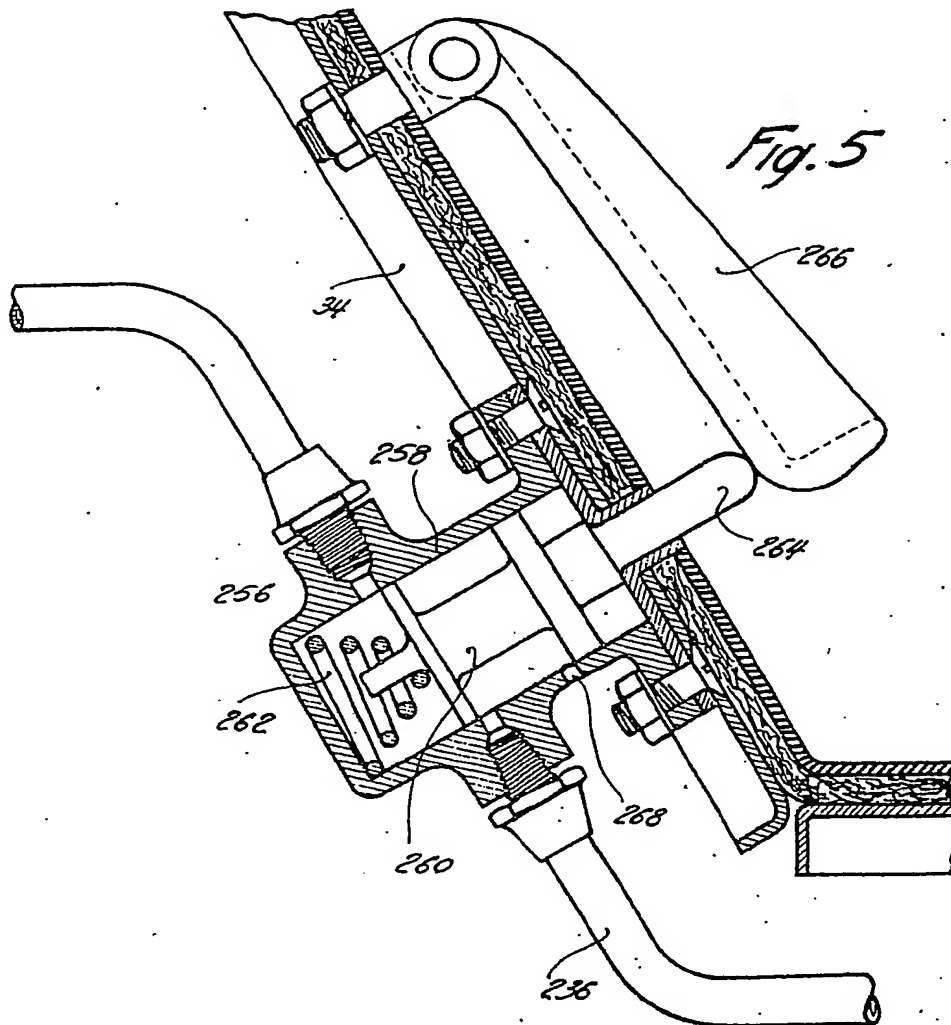
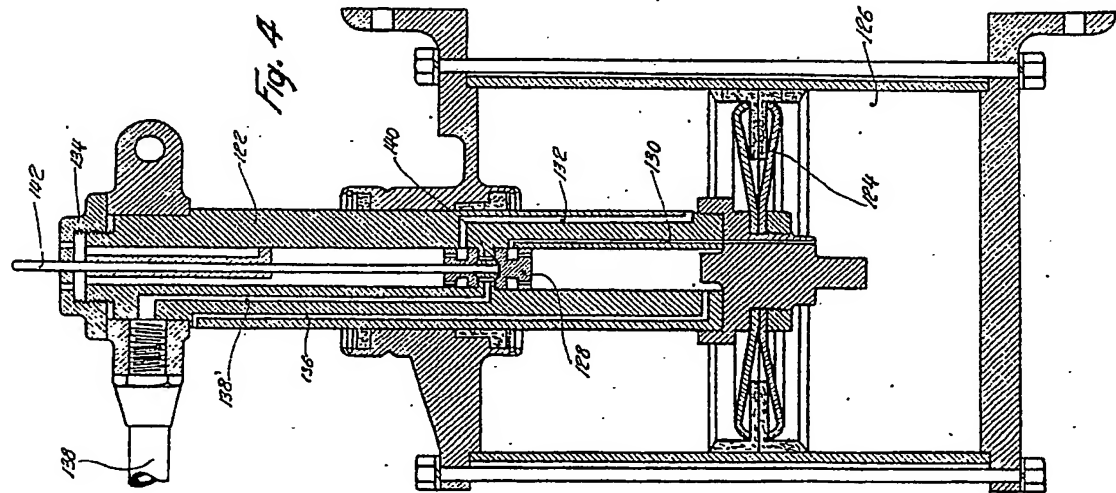


Fig. 3

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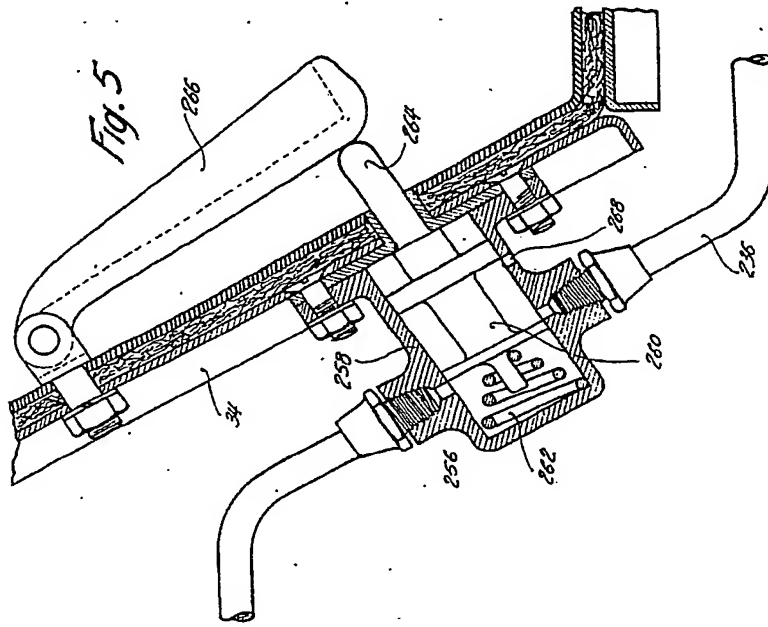
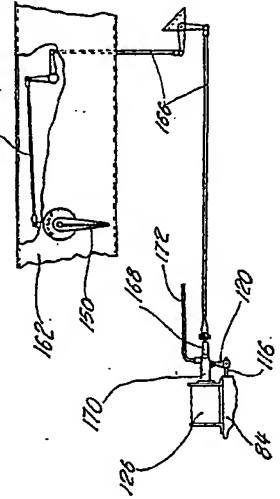
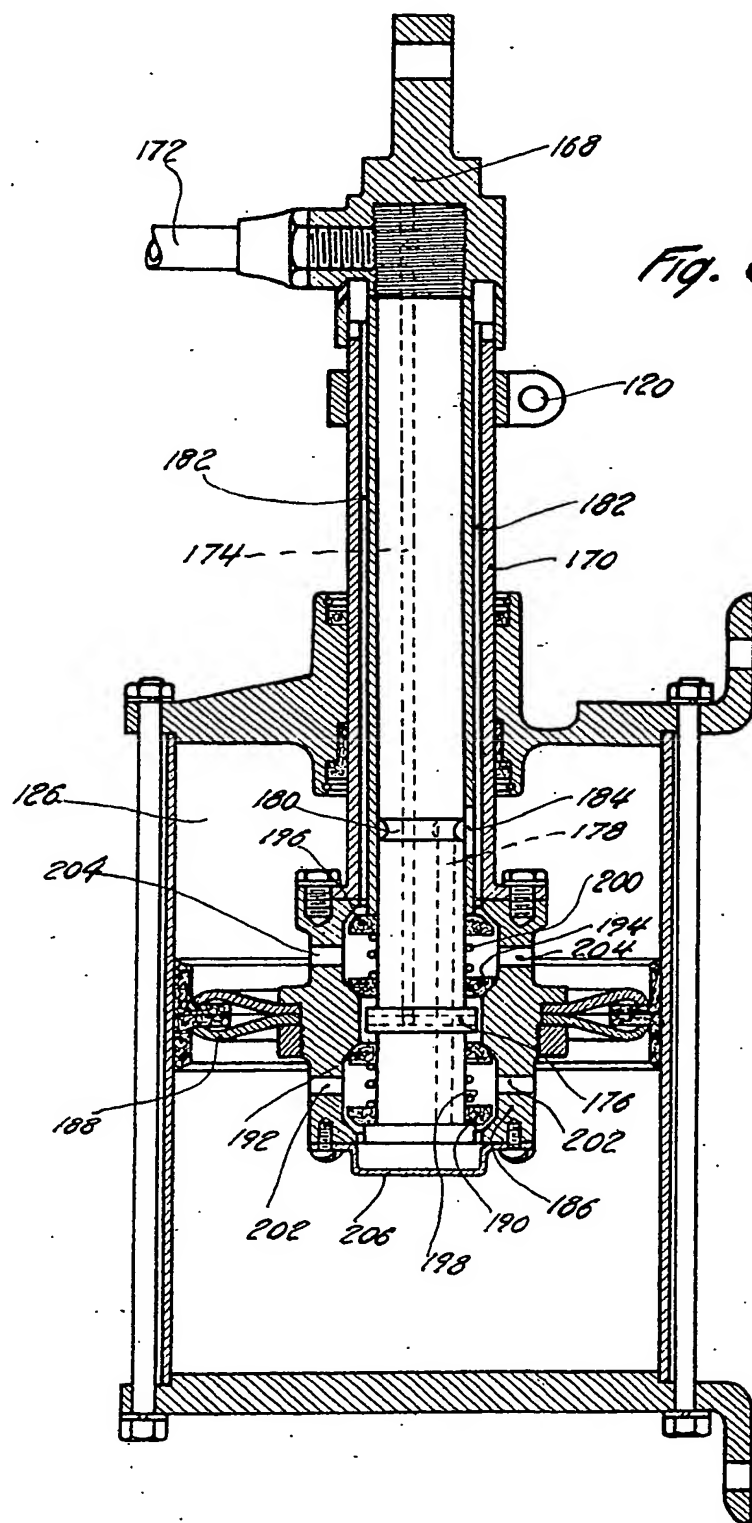


Fig. 7



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